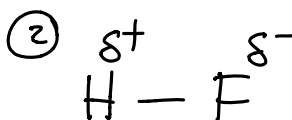
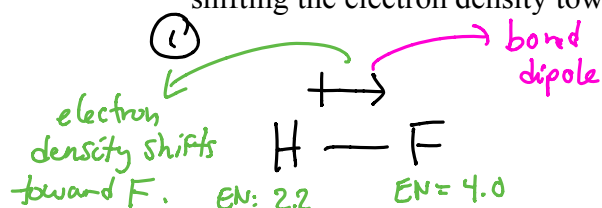


SCH4U – Lesson 8

Polarity and Intermolecular Forces

Bond Polarity

- Recall that electronegativity is the ability to attract an electron
- Bond polarity refers to the distribution of electron density amongst the bonded atoms:
 - A covalent bond is polar when the electronegativity is between 0.4 and 1.7.
 - The most electronegative atom will exert a greater pull on the shared electrons, shifting the electron density towards it.



Molecular polarity

- Molecular polarity refers to the distribution of electron density amongst the atoms that make up a molecule.
- Factors determining the polarity of a molecule:
 - Molecular shape, particularly symmetry.
 - Symmetric: Electron density is evenly distributed around the molecule
 - Asymmetric: electron density is unevenly distributed about the molecule
 - Bond polarity.

- Assessing the polarity of a molecule:

① Shape of the molecule

Lewis structure
+
VSEPR

② Look at the bond polarities.

③ Look at the distribution of e^- .

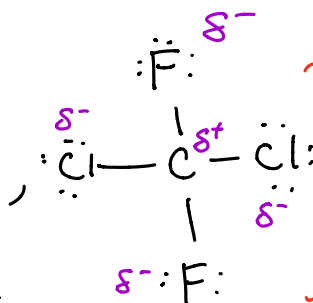
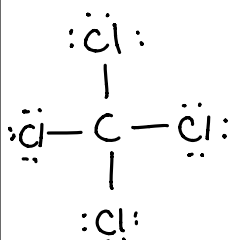
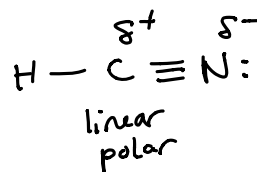
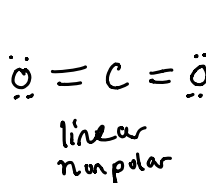
Electron distribution

Symmetric

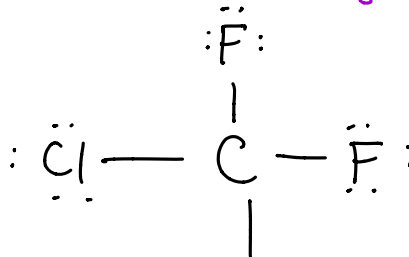
Asymmetrical

non-polar

polar



~~non-polar~~
POLAR!



Polar ✓



Intramolecular forces

- Intramolecular forces: forces within a molecule
- Three types of intramolecular forces:

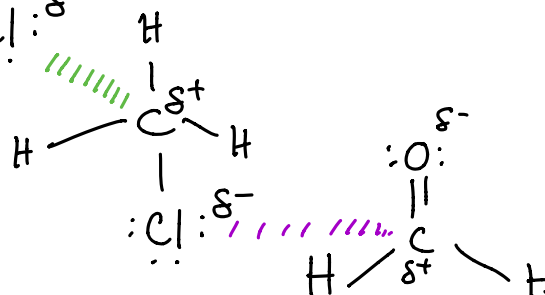
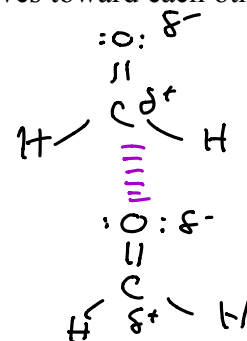
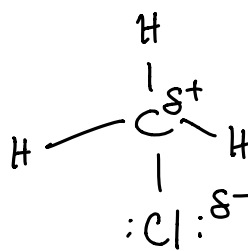
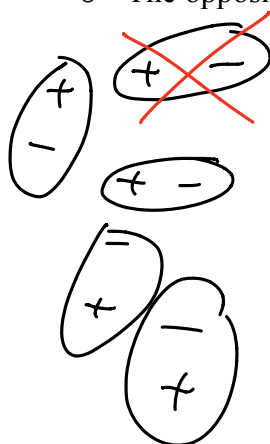
ionic, covalent, metallic bonding

Intermolecular forces

- ~~Intra~~ ^{Inter} molecular forces: forces between molecules

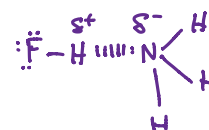
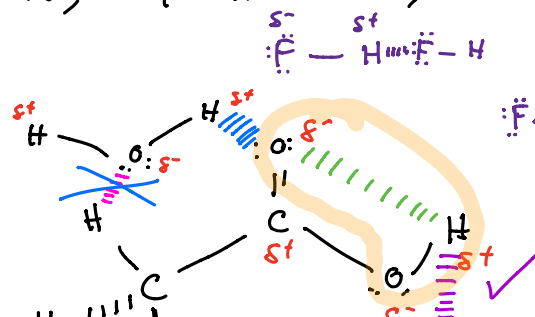
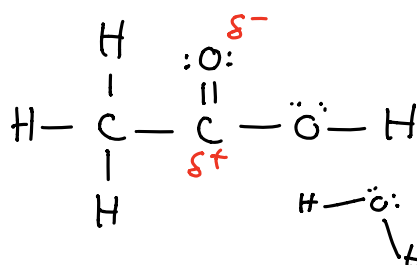
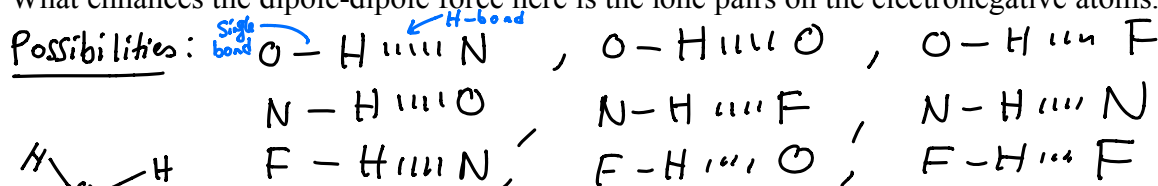
Dipole-Dipole:

- Present when region in the molecule has a permanent partial negative charge and another region has a permanent partial positive charge.
- The opposite charged regions of neighbouring molecules will align themselves toward each other.



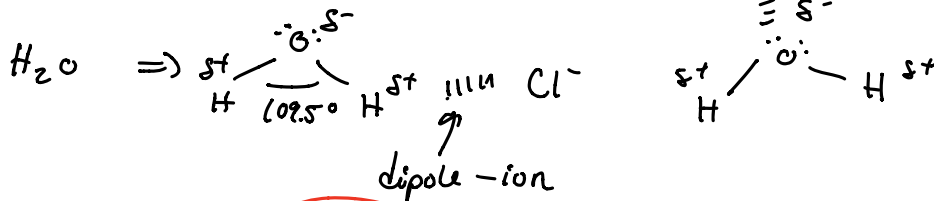
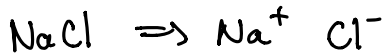
Hydrogen bonding (dipole-dipole)

- A specific dipole-dipole interaction that is stronger than the other intermolecular forces.
- Happens between a H that is bonded to a highly electronegative atom (ex: N, O, F) and a highly electronegative atom on a neighbouring molecule.
- What enhances the dipole-dipole force here is the lone pairs on the electronegative atoms.

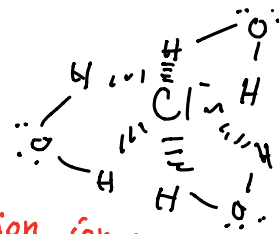
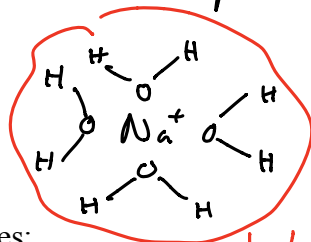


- Ion-dipole

- The electrostatic attraction between ions and dipoles.
- Strength depends on: 1. charge and size of ion and 2. magnitude of dipole and size of molecule



NaCl in water:
(hydrated ion).

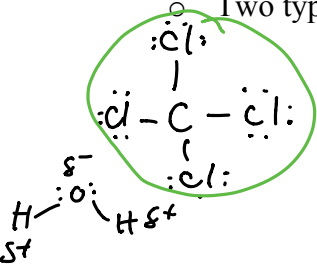


- Induced dipole forces:

- Formation of a dipole in a non-polar molecule.
- Distorted electron distribution (only for a brief instant, not permanent)
- Two types: 1. Dipole-induced dipole forces

2. Ion-induced dipole forces

* short lived displacement



Non-polar

dipole-induced

ion-induced

dipole-induced dipole

ion-induced dipole

polar

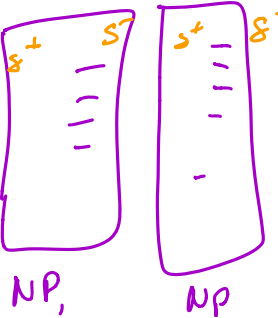
non-polar has a temporary dipole
dispersion

non-polar molecule has a temporary dipole.

- Dispersion forces (London forces):

- Present in all molecules, but: the only attractive force *between* non-polar molecules.
- Non-polar molecules form temporary dipoles: shared electrons are in constant motion
 - Temporary dipole will induce a dipole on other neighbouring non-polar molecules, which in turn can induce a dipole on another neighbouring non-polar molecule (and so on).

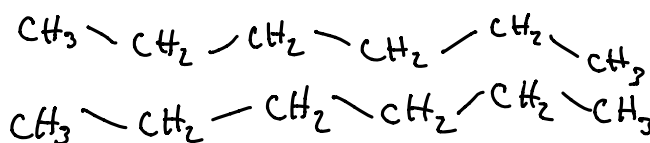
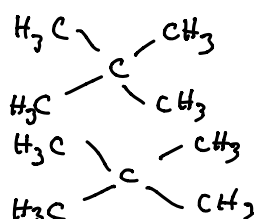
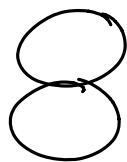
weakest of all forces



- Two factors affect the magnitude of these forces:

① Mass (increase of electrons, thus more likely to have a temporary dipole)

- Surface area (is the area of contact big – think sphere or linear shape)



- Which intermolecular forces can be present in:

Between polar molecules

- dipole-dipole
- H-bond
- ion-dipole
- London dispersion forces

Between non polar

- London dispersion
- induced-dipole.

Properties of Polar Covalent Molecules

- Intermolecular forces stronger than those of nonpolar covalent compounds due to the presence of dipoles.
- Polar covalent molecules:
 - tend to have _____ melting points and boiling points.
 - are more likely to be _____ and _____ at room temperature.
 - will dissolve in polar solvents if hydrogen bonds are present.
 - will _____ conduct electricity to an appreciable degree (some can ionize in solution)

Properties of Non-Polar Covalent Molecules

- Low melting and boiling points.
- Given the low intermolecular forces that exist in nonpolar molecules:
 - tend to have _____ melting and boiling points.
 - they are usually _____ at room temperature.
 - soluble in _____ solvents.
 - will _____ conduct electricity.

